Agdex 100/81-6

Average Analysis of Alberta Feeds
1976 - 1986

Alberta
AGRICULTURE

Average Analysis of Alberta Feeds
1976 - 1986

Alberta
AGRICULTURE

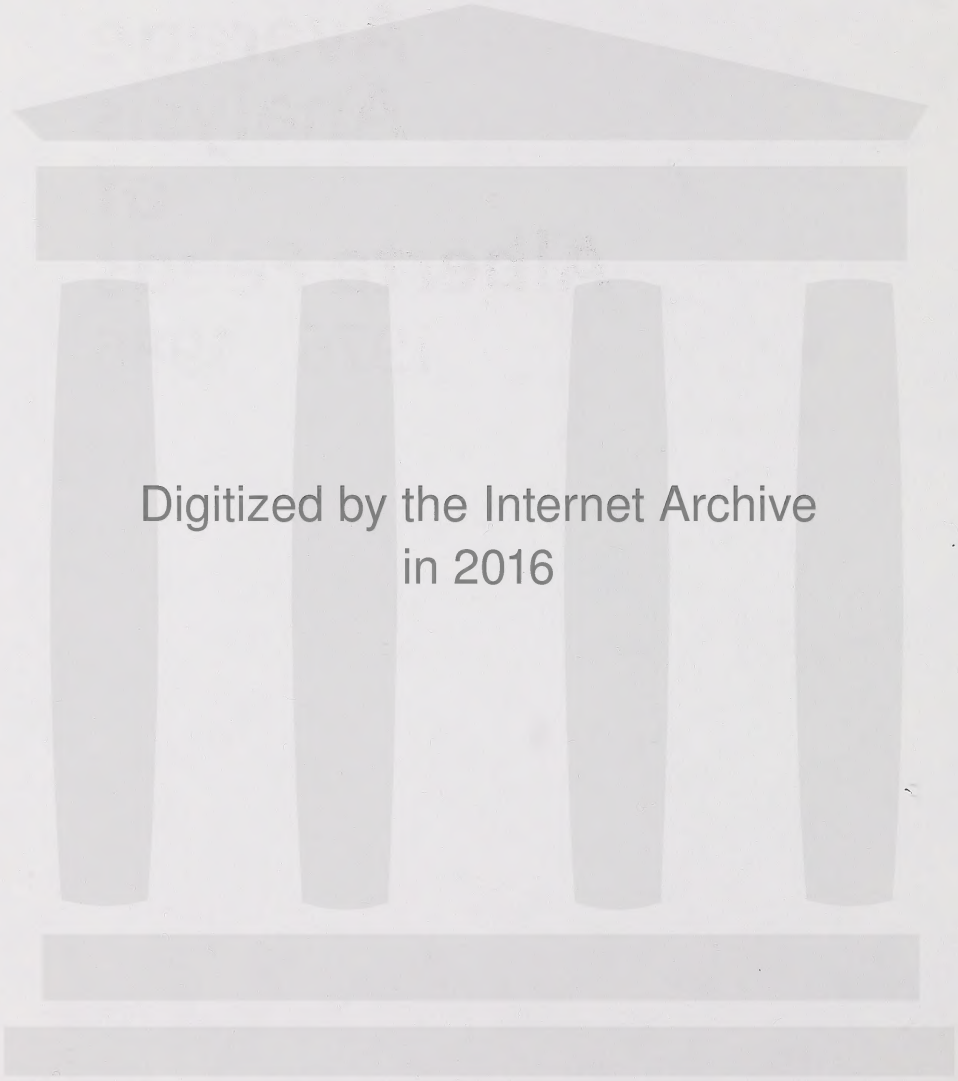

Table Of Contents

Introduction

Alberta Agriculture's Soils and Animal Nutrition Laboratory (A.S.A.N.L.) has been analyzing feed samples submitted by Alberta farmers and ranchers since 1957. The purpose of the feed analysis program is to determine nutrient concentrations in specific grains and roughages, and to recommend rations and management programs based on the analyses of the feeds and the information provided by the farmer.

Ideally, feeding recommendations should be made on the basis of specific feed analyses. However, feed companies and large-scale livestock producers find it infeasible to analyze all feeds which they use or purchase and, thus, must utilize mean (average) feed analysis data in ration formulation and feed purchasing. The data in this publication will be of assistance to people who require information on nutrient concentrations in feeds grown in Alberta.

This publication contains a summary of analyses of feeds submitted by Alberta producers during the period of July 1, 1976 to June 30, 1986. All data, with the exception of bushel weight and moisture, are reported on a moisture free (dry) basis. As well as reporting the average analyses for grains, roughages, and by-product feeds, the average macro and trace mineral contents of feedstuffs are also reported. In addition, frequency distribution of selenium, copper, zinc and manganese levels in several common Alberta feeds for the period 1980-1986 are reported.

While the mean concentrations of nutrients are perhaps the most meaningful data in this publication, special attention should be given to the ranges and standard deviations (S.D.). Nutritionists will usually formulate on the basis of mean values and coefficients of variation, unless they have analyses of the specific feeds being used.

Alberta feed manufacturers and feeders should be aware of the wide variations in concentrations of some nutrients in certain feeds and the minimal variation in others. However, caution must be exercised in using data where very few samples were received. Trends observed in these cases may not be realistic.

We hope that this publication will be of use to persons in the Alberta livestock industry. Nutritionists at the Soils and Animal Nutrition Laboratory would be pleased to receive any questions or comments you may have about this publication.

Prepared By:

Abdullatif I.H. Suleiman, M.Sc., P.Ag.
Laboratory Nutritionist
Beef Cattle and Sheep Branch
Agricultural Soils and Animal Nutrition Laboratory
O.S. Longman Building, 6909-116 Street
Edmonton, Alberta, Canada
T6H 4P2

March, 1987

Glossary Of Terms Used In This Publication

ADF (Acid-Detergent Fibre) - The fibrous (least-digestible) portion of roughage. The ADF fraction consists of lignin and cellulose. Roughages high in ADF are lower in digestible energy than roughages which contain low levels of ADF.

Moisture-Free Basis - The concentration of a nutrient expressed on a moisture-free (dry) basis is the concentration of that nutrient in the completely dry portion of the feed. Expressing the nutrient content in this way allows us to make comparisons between feeds that have different moisture contents. In this publication, all values, except those of moisutre and bushel weight are on a moisture-free (dry) basis.

To convert moisture-free (dry) values to as-fed values, use the following formula:

$$\text{Analysis (as-fed)} = \text{Analysis (dry)} \times \frac{(100 - \%\ \text{Moisutre})}{100}$$

Protein - Values given in the tables are for total (crude) protein. Crude protein is calculated by multiplying the determined % nitrogen in a feed by 6.25.

Range - The maximum and minimum nutrient concentrations observed in feed samples analyzed. Inaccurate identification of the sample by the farmer or the laboratory may have been responsible for the wide ranges observed in certain feed types.

S.D. (Standard Deviation) - A measure of dispersion of values. Normally 66.7% of all values fall within plus or minus (±) one standard deviation from the mean while 95% of the values fall within (±) 1.96 standard deviations from the mean. For example, the mean bushel weight of barley in Alberta is listed in this publication (page 3) as 47.0. Since the S.D. is 4.5 lb, two-thirds of the values for bushel weight in barley fall in the range of 38.2 - 51.5 lb (i.e. 47.0 ± 4.5) and 95% of the values fall in the range of 37.8 - 55.8 lb (i.e. 47.0 ± 1.96 X [4.5]). Values that were within ±3 S.D. were used in compilation of averages (i.e. approximately 99% of all the values were included).

Unsp. - Unspecified.

Acknowledgement:

Assistance of Keith Toogood of Systems Development Branch of Alberta Agriculture in the production of this publication is hereby gratefully acknowledged.

Table 1: Regular Feed Analyses for GRAINS[1].

Feed Type		Number of Samples	Bushel Weight (lb)	Moisture (%)	Protein (%)	Calcium (%)	Phosphorus (%)
CEREALS							
Barley		2689					
	Mean		47.0	11.5	12.5	0.07	0.38
	Range		31.6-62.1	6.5-16.7	7.6-18.1	0.02-0.12	0.22-0.53
	S.D.		4.5	1.8	1.9	0.02	0.05
Oats		1064					
	Mean		38.6	9.8	11.3	0.08	0.34
	Range		25.0-52.3	5.5-14.1	6.3-16.7	0.03-0.13	0.20-0.48
	S.D.		3.9	1.5	1.9	0.02	0.04
Spring Wheat		161					
	Mean		59.7	11.0	16.1	0.06	0.39
	Range		48.6-68.0	7.3-15.5	12.3-20.2	0.03-0.12	0.22-0.51
	S.D.		3.6	1.8	1.9	0.02	0.05
Utility Wheat		23					
	Mean		60.0	11.5	14.6	0.07	0.35
	Range		51.8-66.1	8.1-14.5	11.6-17.7	0.03-0.12	0.26-0.46
	S.D.		3.4	1.3	1.5	0.02	0.05
Fall Wheat		46					
	Mean		61.6	9.2	13.7	0.07	0.32
	Range		49.4-70.9	7.4-12.7	9.6-17.9	0.04-0.12	0.22-0.42
	S.D.		4.3	1.2	1.9	0.02	0.04
High Moisture Barley		203					
	Mean		-	29.8	12.9	0.07	0.38
	Range		-	20.0-52.9	8.7-17.9	0.03-0.13	0.27-0.49
	S.D.		-	7.7	1.7	0.02	0.04

[1] Except for bushel weight, reported on moisture free basis.

Table 1: Regular Feed Analyses for GRAINS[1] (Cont'd)

Feed Type		Number of Samples	Bushel Weight (lb)	Moisture (%)	Protein (%)	Calcium (%)	Phosphorus (%)
OTHER GRAINS							
Fababeans		69					
	Mean		56.8	12.5	29.0	0.11	0.44
	Range		44.9-65.8	7.1-17.1	24.2-32.8	0.06-0.15	0.25-0.58
	S.D.		5.4	1.9	1.8	0.02	0.07
Canola		141					
	Mean		55.8	6.2	24.1	0.39	0.66
	Range		48.6-59.7	4.1-9.9	17.4-28.8	0.23-0.61	0.42-0.91
	S.D.		1.9	1.2	2.2	0.07	0.12
Triticale		71					
	Mean		51.5	9.8	16.1	0.06	0.34
	Range		40.1-59.0	7.8-14.1	11.2-22.4	0.03-0.13	0.18-0.47
	S.D.		4.1	1.6	2.3	0.03	0.08
Field Peas		78					
	Mean		59.4	11.7	24.1	0.10	0.40
	Range		41.9-67.6	7.0-17.1	12.0-37.0	0.04-0.24	0.27-0.60
	S.D.		5.8	2.2	4.5	0.03	0.07
Corn		16					
	Mean		49.9	7.9	10.8	0.05	0.34
	Range		39.8-61.1	3.3-16.1	9.7-11.8	0.01-0.09	0.24-0.41
	S.D.		6.5	4.9	0.6	0.02	0.05

[1] Except for bushel weight, reported on moisture free basis.

Table 2: Regular Feed Analyses for LEGUME HAYS (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
LEGUMES							
Legume (unsp.)		60					
	Mean		12.2	19.8	27.3	1.83	0.21
	Range		6.9-22.9	10.7-28.6	23.0-43.0	1.20-3.10	0.10-0.32
	S.D.		4.3	3.3	5.2	0.42	0.05
Alfalfa		2480					
	Mean		12.1	18.2	33.8	1.71	0.21
	Range		3.3-25.2	9.6-26.9	15.2-52.0	1.08-3.04	0.07-0.36
	S.D.		4.4	2.9	6.4	0.43	0.05
Clover (unsp.)		225					
	Mean		13.8	15.3	41.0	1.38	0.21
	Range		5.5-29.5	8.8-22.2	19.6-59.6	1.00-2.16	0.08-0.36
	S.D.		5.6	2.4	7.2	0.25	0.05
Sweet Clover		34					
	Mean		12.8	16.8	33.8	1.65	0.22
	Range		7.9-24.6	8.4-23.5	22.0-46.6	1.01-3.05	0.12-0.34
	S.D.		4.5	4.1	6.4	0.53	0.06
Sainfoin		19					
	Mean		9.2	16.5	35.2	1.35	0.22
	Range		6.1-13.6	13.6-23.6	23.8-47.6	1.04-1.97	0.14-0.29
	S.D.		2.0	2.4	5.4	0.30	0.04
Cicer Milkvetch		17					
	Mean		8.6	21.0	25.9	2.0	0.26
	Range		7.4-10.6	17.5-24.1	15.3-31.0	1.29-2.87	0.16-0.37
	S.D.		0.9	2.1	3.7	0.44	0.04
Birdsfoot Trefoil		10					
	Mean		10.1	18.0	33.2	1.42	0.25
	Range		6.0-17.0	14.2-21.0	24.0-41.0	1.04-1.79	0.14-0.33
	S.D.		3.8	2.4	4.9	0.23	0.06

Table 3: Regular Feed Analyses for LEGUME-GRASS MIXTURES And GRASS HAYS (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
LEGUME GRASS MIXTURES							
Legume-Grass		4928					
	Mean		12.8	13.4	36.4	1.13	0.19
	Range		1.8-26.7	4.1-24.3	14.9-57.7	0.14-2.72	0.04-0.35
	S.D.		4.6	3.6	7.3	0.53	0.05
Alfalfa-Grass		3668					
	Mean		12.6	14.0	35.8	1.22	0.19
	Range		1.8-26.1	4.1-24.4	14.9-54.9	0.14-2.83	0.05-0.35
	S.D.		4.5	3.5	7.0	0.53	0.05
Clover-Grass		871					
	Mean		13.8	10.8	39.4	0.79	0.18
	Range		4.7-28.7	4.5-19.6	23.4-56.4	0.16-1.74	0.02-0.35
	S.D.		5.1	3.0	6.2	0.33	0.06
GRASSES							
Grass (unsp.)		350					
	Mean		10.1	10.7	32.0	0.53	0.17
	Range		2.3-25.0	3.0-22.0	27.0-48.5	0.11-1.00	0.04-0.36
	S.D.		4.9	3.8	4.9	0.20	0.06
Native Grass		178					
	Mean		9.0	8.6	38.4	0.44	0.12
	Range		3.6-22.4	2.7-18.6	28.4-55.7	0.11-1.00	0.02-0.29
	S.D.		4.5	3.4	4.7	0.19	0.06
Slough Grass		135					
	Mean		10.7	9.7	37.0	0.42	0.14
	Range		4.3-25.0	5.7-14.7	28.0-50.1	0.12-0.90	0.04-0.29
	S.D.		5.3	2.1	4.0	0.17	0.05
Brome Grass		392					
	Mean		10.2	10.6	36.2	0.46	0.17
	Range		3.5-23.0	3.7-22.5	21.4-54.8	0.16-0.99	0.04-0.43
	S.D.		4.4	6.9	4.0	0.19	0.08
Timothy		384					
	Mean		11.8	8.9	38.4	0.49	0.16
	Range		4.4-26.6	2.4-17.6	26.6-52.6	0.10-1.00	0.03-0.33
	S.D.		4.9	2.9	6.7	0.20	0.07

Table 3: Regular Feed Analyses for LEGUME-GRASS MIXTURES And GRASS HAYS (moisture-free basis).

Feed Type	Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
GRASSES (Cont'd)						
Creeping Red Fescue	49					
Mean		10.0	9.3	35.8	0.52	0.18
Range		3.3-21.9	3.2-19.2	26.1-53.0	0.19-1.00	0.02-0.36
S.D.		4.1	3.6	5.9	0.19	0.07
Crested Wheatgrass	113					
Mean		8.7	11.2	36.0	0.37	0.16
Range		5.1-16.9	4.0-23.8	21.0-54.8	0.10-0.90	0.04-0.30
S.D.		2.8	4.8	7.0	0.17	0.05
Russian Wildrye	38					
Mean		7.7	7.9	40.1	0.39	0.13
Range		5.4-13.0	2.4-22.7	25.7-48.7	0.18-0.83	0.03-0.30
S.D.		1.8	5.1	5.2	0.18	0.08
Orchard Grass	28					
Mean		11.6	12.9	34.1	0.46	0.22
Range		7.3-23.4	3.8-20.8	25.9-41.7	0.16-0.83	0.12-0.36
S.D.		3.9	5.0	4.7	0.17	0.06
Reed Canary Grass	33					
Mean		11.0	11.4	36.5	0.45	0.18
Range		6.6-19.5	4.2-21.1	31.9-46.7	0.13-0.78	0.05-0.30
S.D.		3.8	4.4	4.4	0.18	0.06
Meadow Foxtail	33					
Mean		10.1	11.3	34.6	0.42	0.22
Range		5.3-24.5	3.7-22.6	25.7-42.5	0.20-0.84	0.07-0.42
S.D.		4.8	4.3	4.4	0.17	0.07
Kentucky Bluegrass	11					
Mean		9.5	12.6	34.2	0.52	0.20
Range		6.8-14.1	7.4-16.9	27.6-43.7	0.24-0.91	0.14-0.29
S.D.		2.0	3.4	5.3	0.21	0.05
Rye Grass	10					
Mean		14.3	13.2	35.0	0.47	0.22
Range		7.8-25.9	6.5-22.8	29.7-41.5	0.16-0.74	0.08-0.53
S.D.		6.9	5.2	4.2	0.15	0.11

Table 4: Regular Feed Analyses For CEREAL HAYS (greenfeeds).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
CEREALS							
Barley		753					
	Mean		14.1	11.8	23.8	0.41	0.22
	Range		3.0-29.9	2.4-23.0	8.7-45.0	0.09-0.94	0.02-0.43
	S.D.		6.2	3.9	6.2	0.18	0.07
Oats		1476					
	Mean		14.2	9.9	31.7	0.32	0.20
	Range		2.8-30.0	2.1-18.5	19.7-48.0	0.08-1.02	0.03-0.40
	S.D.		6.2	2.8	5.5	0.23	0.07
Wheat		257					
	Mean		13.7	10.2	29.4	0.20	0.18
	Range		1.9-29.4	2.4-20.5	27.2-43.0	0.06-0.45	0.03-0.38
	S.D.		6.0	3.5	4.4	0.08	0.07
Mixed Cereal		62					
	Mean		14.6	10.4	34.5	0.43	0.21
	Range		2.7-26.2	5.4-18.9	22.8-51.8	0.16-1.00	0.10-0.39
	S.D.		6.4	3.1	5.3	0.19	0.06
Triticale		36					
	Mean		9.8	9.9	34.2	0.22	0.17
	Range		6.0-17.3	6.1-17.9	28.2-38.6	0.09-0.46	0.07-0.32
	S.D.		2.8	2.7	2.6	0.09	0.07
Rye		67					
	Mean		13.5	8.9	38.9	0.26	0.16
	Range		5.9-27.3	4.3-16.3	24.6-53.8	0.13-0.70	0.06-0.29
	S.D.		5.1	2.6	5.6	0.21	0.05
OTHER							
Canola		14					
	Mean		13.9	11.7	39.2	1.59	0.41
	Range		9.8-25.7	10.1-14.8	21.8-43.8	1.08-2.23	0.19-0.58
	S.D.		3.1	1.9	4.3	0.29	0.09

Table 5: Regular Feed Analyses for CEREAL SILAGES (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
CEREALS							
Barley		699					
	Mean		63.2	11.1	32.8	0.46	0.26
	Range		37.8-87.6	4.3-18.8	8.5-48.5	0.08-1.06	0.12-0.43
	S.D.		8.3	2.64	5.2	0.21	0.06
Oats		201					
	Mean		62.1	10.6	36.3	0.39	0.24
	Range		33.8-86.0	4.4-18.8	26.1-57.1	0.07-1.01	0.10-0.38
	S.D.		9.5	2.7	8.3	0.24	0.05
Corn		203					
	Mean		71.2	10.0	31.2	0.28	0.23
	Range		54.8-84.1	5.3-15.6	21.2-40.7	0.04-0.63	0.12-0.38
	S.D.		6.0	2.0	3.6	0.13	0.05
Mixed Cereal		93					
	Mean		62.1	11.0	35.8	0.48	0.26
	Range		37.2-79.8	6.3-18.3	23.0-52.2	0.15-1.21	0.13-0.45
	S.D.		6.1	2.4	6.1	0.28	0.06
Triticale		40					
	Mean		60.3	10.4	33.1	0.31	0.24
	Range		40.6-74.2	5.9-18.4	25.4-45.6	0.16-0.57	0.16-0.31
	S.D.		7.0	2.9	4.2	0.10	0.04
Wheat		29					
	Mean		57.0	11.2	37.8	0.25	0.24
	Range		32.1-76.6	6.5-18.5	28.6-50.7	0.11-0.49	0.16-0.39
	S.D.		10.9	3.3	5.9	0.10	0.15

Table 6: Regular Feed Analyses for LEGUME SILAGES (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
LEGUMES							
Alfalfa		308					
	Mean		55.4	18.2	36.1	1.77	0.25
	Range		30.3-86.7	10.6-25.7	21.9-51.6	1.02-2.86	0.15-0.40
	S.D.		11.6	2.5	5.6	0.37	0.05
Clover (unsp.)		141					
	Mean		63.5	14.7	42.6	1.39	0.21
	Range		33.4-88.0	10.7-20.6	27.6-57.9	1.00-1.90	0.11-0.35
	S.D.		10.0	2.0	6.4	0.21	0.05
Sweetclover		16					
	Mean		64.4	16.1	39.7	1.30	0.22
	Range		45.0-81.5	7.8-20.5	28.1-63.0	1.04-1.71	0.01-0.33
	S.D.		9.9	3.7	7.9	0.21	0.07
Fababeans		21					
	Mean		70.7	17.3	36.3	1.18	0.25
	Range		54.5-85.0	13.1-22.8	24.1-45.1	1.00-1.47	0.17-0.36
	S.D.		7.4	2.7	5.5	0.13	0.05

Table 7: Regular Feed Analyses of GRASS and LEGUME-GRASS MIXTURES AND OTHER SILAGES (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
Grass (unsp.)		27					
	Mean		60.9	14.6	37.0	0.70	0.27
	Range		32.8-80.5	8.3-31.5	21.8-48.5	0.40-1.00	0.12-0.58
	S.D.		11.7	6.8	6.6	0.19	0.13
Kentucky Bluegrass		11					
	Mean		63.5	15.6	34.7	0.46	0.35
	Range		37.5-81.7	10.0-21.3	32.5-37.5	0.36-0.72	0.21-0.51
	S.D.		13.0	4.0	1.7	0.10	0.10
Brome		6					
	Mean		57.3	10.5	37.1	0.53	0.20
	Range		46.0-67.5	8.8-12.0	26.3-46.7	0.33-0.80	0.14-0.28
	S.D.		9.2	1.2	7.9	0.19	0.20
Legume-Grass		660					
	Mean		58.2	14.3	38.2	1.23	0.23
	Range		30.3-85.0	6.8-22.6	24.7-56.1	0.20-2.66	0.09-0.38
	S.D.		11.0	2.9	7.8	0.47	0.05
Alfalfa-Grass		465					
	Mean		56.8	14.6	37.8	1.32	0.23
	Range		30.3-79.2	6.8-23.3	24.7-54.3	0.28-2.67	0.12-0.38
	S.D.		10.9	2.9	4.9	0.46	0.05
Clover-Grass		145					
	Mean		61.1	13.8	39.6	1.07	0.21
	Range		34.6-85.0	7.4-21.1	25.7-56.1	0.20-1.97	0.09-0.32
	S.D.		11.3	2.6	5.9	0.37	0.04
OTHER SILAGES							
Canola		13					
	Mean		65.3	13.9	42.3	1.23	0.31
	Range		30.2-83.3	8.1-20.5	26.5-55.2	0.69-2.06	0.21-0.48
	S.D.		8.7	3.2	8.5	0.36	0.08
Sunflower		6					
	Mean		74.5	12.2	33.8	1.29	0.21
	Range		63.0-84.7	11.0-13.9	28.7-42.8	1.01-1.59	0.17-0.27
	S.D.		8.7	1.1	-	0.23	0.04

Table 7: Regular Feed Analyses of GRASS and LEGUME-GRASS MIXTURES AND OTHER SILAGES (moisture-free basis).

Feed Type	Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
OTHER SILAGES (Cont'd)						
Peas* + Other	179					
Mean		62.5	12.1	34.9	0.64	0.27
Range		40.3-85.2	6.5-20.5	23.6-47.7	0.22-1.31	0.12-0.46
S.D.		8.6	2.6	4.2	0.23	0.07
Fababean* + Other	79					
Mean		65.4	15.2	38.1	0.93	0.26
Range		35.1-85.0	7.7-24.1	24.1-48.1	0.40-1.52	0.14-0.37
S.D.		10.3	3.4	4.5	0.25	0.05
Canola* + Other	36					
Mean		65.9	14.1	39.3	1.10	0.31
Range		36.5-83.3	8.1-20.5	26.5-55.2	0.25-2.06	0.19-0.48
S.D.		9.2	3.0	6.9	0.43	0.07

* Primary crop in the mixed crop silage.

Table 8: Regular Feed Analyses of CEREAL and OTHER STRAWS (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
CEREALS							
Barley		424					
	Mean		10.9	5.6*	47.1	0.35	0.10
	Range		3.8-19.8	3.8-14.6	29.3-60.6	0.06-0.73	0.01-0.30
	S.D.		4.3	2.5	6.5	0.13	0.07
Oats		225					
	Mean		10.8	4.7*	47.1	0.26	0.10
	Range		2.7-19.9	0.70-11.6	25.1-58.5	0.07-0.63	0.01-0.34
	S.D.		4.6	2.1	6.3	0.10	0.06
Wheat		134					
	Mean		10.9	4.3*	49.0	0.20	0.06
	Range		3.9-19.7	1.4-10.0	32.4-59.8	0.08-0.47	0.01-0.23
	S.D.		4.4	1.7	5.4	0.09	0.06
Mixed Cereal		823					
	Mean		11.0	5.1*	47.4	0.30	0.09
	Range		2.7-19.9	0.70-13.6	25.1-60.6	0.06-0.73	0.01-0.32
	S.D.		4.4	2.3	6.3	0.14	0.06
OTHER STRAWS							
Flax		25					
	Mean		9.9	4.7	55.3	0.54	0.07
	Range		5.7-22.1	1.6-12.4	37.2-72.6	0.35-0.94	0.01-0.28
	S.D.		4.1	2.4	6.7	0.18	0.08
Peas		6					
	Mean		8.0	7.6	54.3	1.08	0.11
	Range		6.2-9.0	4.9-13.0	42.8-63.2	0.76-1.33	0.05-0.19
	S.D.		1.1	3.1	7.7	0.20	0.05
Canola		7					
	Mean		14.8	7.8	54.8	1.38	0.19
	Range		8.7-24.3	4.9-9.9	41.3-62.5	1.27-1.45	0.11-0.26
	S.D.		5.2	2.3	7.3	0.20	0.08

* Samples included some ammoniated straws, giving high mean protein values.

Table 9: Regular Feed Analyses of CHAFFS (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
CEREALS							
Barley		12					
	Mean		10.2	7.0*	33.4	0.50	0.13
	Range		6.3-14.1	3.8-10.1	29.4-37.6	0.19-0.86	0.05-0.28
	S.D.		2.5	2.2	3.1	0.22	0.06
Wheat		10					
	Mean		10.5	5.8*	40.4	0.28	0.09
	Range		5.1-14.2	2.3-10.2	33.3-49.2	0.08-0.65	0.03-0.28
	S.D.		2.7	2.3	4.8	0.20	0.08
Oats		5					
	Mean		10.7	9.2*	31.9	0.50	0.14
	Range		7.4-12.0	5.4-13.5	27.6-38.3	0.19-1.10	0.06-0.23
	S.D.		1.9	3.1	4.6	0.41	0.07
OTHER CHAFFS							
Canola		9					
	Mean		14.7	10.7	47.4	1.73	0.16
	Range		8.7-23.4	9.5-13.9	42.6-52.5	1.10-1.96	0.10-0.34
	S.D.		2.9	1.7	2.1	0.27	0.07

* Samples included some ammoniated chaffs, giving high mean protein values.

Table 10: Regular Feed Analyses of SCREENINGS (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Fibre(ADF) (%)	Calcium (%)	Phosphorus (%)
CEREALS							
Barley		18					
	Mean		8.9	11.7	20.0	0.42	0.31
	Range		3.3-13.6	3.8-26.8	18.6-22.7	0.07-1.37	0.03-0.69
	S.D.		2.6	5.1	2.3	0.46	0.16
Wheat		7					
	Mean		9.5	15.2	19.7	0.26	0.37
	Range		7.7-10.3	12.8-17.1	16.6-22.8	0.04-0.94	0.27-0.49
	S.D.		1.0	1.7	4.3	0.30	0.07
Mixed Cereal		44					
	Mean		9.6	13.5	16.5	0.47	0.36
	Range		4.4-13.6	3.8-26.8	9.0-22.8	0.04-1.51	0.03-0.69
	S.D.		1.8	3.8	4.5	0.44	0.13
OTHER SCREENINGS							
Canola		19					
	Mean		11.1	15.4	16.9	0.71	0.49
	Range		8.6-13.7	11.9-18.2	9.8-24.6	0.26-1.41	0.31-0.79
	S.D.		1.3	2.0	5.0	0.33	0.11

Table 11: Regular Feed Analyses of PROTEIN SUPPLEMENTS (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Crude Fibre (%)	Calcium (%)	Phosphorus (%)
Canola Meal		328					
	Mean		7.5	39.2	14.1	0.73	1.20
	Range		2.0-12.4	31.6-47.9	4.5-21.8	0.31-1.06	0.99-1.41
	S.D.		2.4	2.9	3.5	0.11	0.09
Soybean Meal		58					
	Mean		10.3	51.5	4.5	0.39	0.75
	Range		7.1-12.6	44.4-57.0	2.6-6.4	0.20-0.84	0.58-0.86
	S.D.		1.2	2.5	1.5	0.15	0.05
Meat Meal		8					
	Mean		5.5	52.5	-	7.97	4.03
	Range		3.5-8.0	50.3-54.6	-	6.71-9.62	3.12-4.68
	S.D.		1.5	1.4	-	0.99	0.44
Fish Meal		12					
	Mean		5.2	56.0	-	4.02	2.51
	Range		2.1-14.3	28.2-71.2	-	0.04-9.72	0.51-5.11
	S.D.		3.1	13.5	-	3.34	1.48

Table 12: Regular Feed Analyses of BY-PRODUCT FEEDS (moisture-free basis).

Feed Type		Number of Samples	Moisture (%)	Protein (%)	Crude Fibre (%)	Calcium (%)	Phosphorus (%)
Beet Pulp		8					
	Mean		8.6	10.3	-	0.35	0.09
	Range		7.8-9.6	9.7-11.2	-	0.31-0.43	0.08-0.10
	S.D.		0.6	0.6	-	0.05	0.01
Brewers Grain Solubles		19					
	Mean		75.5	27.3	16.2	0.39	0.64
	Range		69.5-79.5	23.2-32.5	15.4-17.1	0.22-0.77	0.52-0.80
	S.D.		2.8	2.7	1.2	0.14	0.07
Brewers Grain		4					
	Mean		75.4	28.2	15.1	0.43	0.65
	Range		73.0-76.5	25.8-30.8	13.2-16.4	0.34-0.49	0.63-0.69
	S.D.		1.6	2.0	1.3	0.06	0.03
Distillers Grain		4					
	Mean		12.4	29.4	-	0.15	0.78
	Range		11.2-13.7	27.8-31.0	-	0.09-0.22	0.68-0.88
	S.D.		1.7	2.2	-	0.09	0.14
Brewers Yeast		3					
	Mean		85.9	34.7	-	-	1.09
	Range		83.8-87.4	11.6-50.5	-	-	0.34-1.70
	S.D.		1.8	20.4	-	-	0.69
Grain Dust		4					
	Mean		10.0	8.9	28.9*	0.71	0.24
	Range		7.9-11.1	7.2-9.9	27.0-30.6	0.22-1.17	0.18-0.28
	S.D.		1.4	1.2	1.5	0.48	0.04
Oat Hulls		2					
	Mean		7.7	3.2	-	0.07	0.10
	Range		7.5-7.8	2.5-3.9	-	0.05-0.09	0.09-0.10
	S.D.		0.2	1.0	-	0.03	0.01
Liquid Whey		5					
	Mean		93.8	14.7	-	5.4	0.91
	Range		92.9-94.8	13.5-15.7	-	0.63-14.1	0.63-1.14
	S.D.		-	0.9	-	7.5	0.22

* ADF

Table 13: Average Macro and Trace Mineral Contents of GRAINS (1976-1986)

	Parts Per Million (ppm)							Per Cent (%)				Parts Per Billion
	Cu	Mn	Zn	Al	Co	Fe	Mo	Mg	K	Na	S	Se*
CEREALS												
Barley	6.5(248)	18.8(219)	41.2(245)	26(35)	0.40(11)	90(111)	1.38(67)	0.14(193)	0.54(193)	0.017(87)	0.13(68)	103(592)
Oats	4.6(143)	43.9(137)	32.6(141)	18(32)	0.24(7)	65(54)	1.02(41)	0.13(116)	0.47(115)	0.017(50)	0.13(45)	114(273)
Spring Wheat	8.2(4)	39.8(2)	45.8(4)	-	-	-	-	0.14(2)	0.39(2)	-	0.20(6)	97(14)
Utility Wheat	4.5(2)	38.8(2)	41.4(2)	3(1)	-	39(1)	-	0.16(2)	0.39(2)	0.001(1)	0.16(1)	121(5)
Fall Wheat	5.3(3)	29.6(3)	44.4(3)	-	-	46(3)	-	0.18(3)	0.47(3)	-	0.23(3)	-
Rye	3.8(3)	20.6(3)	34.6(3)	5(1)	-	32(1)	0.47(1)	0.13(2)	0.53(2)	0.001(1)	0.07(1)	133(3)
Mixed Cereal	5.8(413)	28.9(375)	38.1(40.7)	23(71)	0.34(18)	80(173)	1.23(111)	0.14(328)	0.52(335)	0.017(142)	0.14(130)	109(920)
OTHER GRAINS												
Fababeans	10.6(4)	15.8(4)	58.7(4)	-	-	75(3)	-	0.14(3)	0.94(4)	0.026(2)	-	98(6)
Canola	4.4(4)	40.7(4)	41.5(4)	-	-	238(1)	1.51(1)	0.36(4)	0.86(4)	-	0.62(3)	97(1)
Triticale	5.8(17)	37.6(16)	47.8(17)	-	-	96(1)	-	0.17(16)	0.49(16)	0.002(5)	-	228(8)
Field Peas	5.6(3)	21.1(3)	97.9(3)	13(1)	0.37(1)	97(3)	10.0(1)	0.22(3)	0.98(3)	0.002(3)	0.30(1)	145(7)
Corn	2.5(4)	6.8(4)	22.8(4)	4(2)	-	23(2)	0.73(2)	0.14(3)	0.41(3)	0.001(2)	-	131(3)
Buckwheat	11.1(4)	27.2(4)	25.0(4)	-	-	62(4)	-	0.24(4)	0.56(4)	0.003(4)	-	369(4)

- All values are on moisture-free basis.
- Values in brackets refer to the number of samples analysed.

Table 14: Average Macro and Trace Mineral Contents of LEGUME HAYS (1976-1986)

	Parts Per Million (ppm)							Per Cent (%)				Parts Per Billion
	Cu	Mn	Zn	Al	Co	Fe	Mo	Mg	K	Na	S	Se*
LEGUMES												
Legume (unsp.)	9.4(5)	9.6(5)	30.3(5)	83(5)	-	214(5)	1.44(5)	0.28(6)	1.23(5)	0.011(5)	0.12(5)	275(4)
Alfalfa	7.0(345)	35.7(330)	23.8(340)	522(51)	0.7(24)	337(150)	2.10(89)	0.31(313)	1.74(284)	0.040(115)	0.23(99)	277(554)
Clover	7.3(16)	46.0(15)	28.6(16)	60(2)	0.3(2)	47(52)	1.39(4)	0.37(10)	1.58(9)	0.007(5)	0.14(2)	156(42)
Sweetclover	6.7(1)	19.2(1)	25.7(0)	-	-	-	1.95(1)	0.36(1)	1.57(1)	-	-	635(3)
Sainfoin	6.1(4)	41.6(4)	17.1(4)	71(2)	-	147(4)	3.33(2)	0.30(4)	1.88(4)	0.006(2)	0.13(2)	324(5)
Cicer Milkvetch	5.1(12)	46.9(12)	19.0(12)	-	-	697(12)	-	-	-	-	0.30(12)	25(12)
Peas	4.7(1)	31.8(1)	29.3(1)	68(1)	-	123(1)	4.05(1)	0.46(1)	1.21(1)	0.175(1)	0.18(1)	-

- All values are on moisture-free basis.
- Values in brackets refer to the number of samples analysed.

Table 15: Average Macro and Trace Mineral Contents of LEGUME-GRASS AND GRASS HAYS (1976-1986)

	Parts Per Million (ppm)							Per Cent (%)				Parts Per Billion
	Cu	Mn	Zn	Al	Co	Fe	Mo	Mg	K	Na	S	Se*
LEGUME-GRASS												
MIXTURES												
Legume-grass	6.6(928)	43.6(881)	24.0(910)	119(141)	0.61(48)	139(385)	2.12(275)	0.24(783)	1.57(725)	0.022(267)	0.16(231)	209(1740)
Alfalfa-grass	6.7(729)	40.4(687)	23.4(713)	131(105)	0.51(38)	141(139)	2.34(200)	0.25(630)	1.59(590)	0.024(218)	0.17(168)	233(1345)
Clover-grass	6.5(142)	59.1(139)	27.4(140)	106(25)	0.98(7)	150(53)	1.50(54)	0.22(106)	1.48(100)	0.016(41)	0.14(50)	127(299)
GRASSES												
Grass(unsp.)	5.2(107)	75.0(105)	24.4(105)	625(22)	0.24(1)	359(47)	1.53(29)	0.17(58)	1.20(53)	0.022(32)	0.18(23)	208(138)
Brome	6.6(70)	67.3(64)	20.6(67)	62(15)	0.65(9)	193(43)	2.48(24)	0.16(42)	1.47(420	0.008(23)	0.15(35)	139(106)
Timothy	6.5(64)	55.8(61)	23.0(64)	96(20)	1.02(30)	129(30)	1.82(32)	0.16(59)	1.41(57)	0.043(11)	0.17(28)	142(105)
Crested Wheatgrass	2.9(33)	43.6(32)	23.3(330	106(2)	0.16(1)	296(31)	1.27(6)	0.12(13)	1.18(12)	0.012(7)	0.12(22)	60(36)
Creeping Red Fescue	4.3(30	27.9(2)	20.2(3)	-	-	-	-	0.17(20)	1.28(1)	-	-	83(13)
Russian Wildrye	3.3(1)	48.8(1)	13.6(1)	-	-	595(1)	-	-	-	-	-	269(8)
Orchard Grass	2.3(2)	53.6(2)	26.7(2)	-	-	-	0.78(1)	0.23(2)	1.87(2)	0.008(2)	0.11(1)	490(6)
Reed Canary Grass	4.6(40)	134.8(4)	36.4(4)	779(1)	-	506(2)	8.30(1)	0.32(3)	1.38(3)	0.810(1)	0.75(1)	103(10)
Meadow Foxtail	8.2(5)	165.3(4)	32.5(5)	-	-	107(2)	-	0.18(2)	1.80(2)	0.004(1)	-	46(6)
Native Grass	6.0(63)	65.9(63)	21.1(63)	908(8)	-	297(30)	0.89(13)	0.14(43)	1.07(37)	0.053(28)	0.17(10)	147(83)
Slough Grass	6.6(16)	721(15)	34.7(16)	571(4)	0.81(1)	298(10)	1.67(9)	0.22(14)	1.20(14)	0.189(9)	0.21(8)	121(37)
Ryegrass	6.0(3)	32.0(3)	28.3(3)	61(1)	0.73(1)	129(3)	1.58(1)	0.19(1)	1.63(3)	0.010(3)	0.17(1)	-

- All values are on moisture-free basis.
- Values in brackets refer to the number of samples analysed.

Table 16: Average Macro and Trace Mineral Contents of CEREAL HAYS (1976-1986)

	Parts Per Million (ppm)							Per Cent (%)				Parts Per Billion
	Cu	Mn	Zn	Al	Co	Fe	Mo	Mg	K	Na	S	Se*
CEREALS												
Barley	4.4(80)	30.1(81)	32.6(81)	454(21)	0.30(1)	305(61)	1.19(16)	0.22(78)	1.48(148)	0.123(28)	0.20(122)	208(104)
Oats	5.1(124)	51.4(119)	23.8(122)	73(23)	1.24(9)	195(62)	1.29(39)	0.39(106)	1.81(102)	0.181(49)	0.18(22)	192(258)
Wheat	6.2(19)	49.5(19)	24.4(19)	151(4)	-	353(15)	1.11(8)	0.16(17)	1.33(17)	0.007(11)	0.28(11)	482(24)
Rye	6.5(3)	26.2(3)	19.8(3)	27(1)	0.16(1)	86(1)	0.30(1)	0.17(4)	1.31(3)	0.001(1)	0.15(1)	252(11)
OTHER												
Canola	2.4(16)	41.0(16)	35.3(16)	108(3)	-	841(1)	0.92	0.50(17)	1.88(52)	0.060(3)	0.68(52)	-
Triticale	4.6(10	16.7(1)	26.4(1)	-	-	56(1)	-	0.09(1)	0.88(1)	0.002(1)	-	-

- All values are on moisture-free basis.
- Values in brackets refer to the number of samples analysed.

Table 17: Average Macro and Trace Mineral Contents of CEREAL SILAGES (1976-1986)

	Parts Per Million (ppm)							Per Cent (%)				Parts Per Billion
	Cu	Mn	Zn	Al	Co	Fe	Mo	Mg	K	Na	S	Se*
CEREALS												
Barley	4.8(91)	37.1(99)	32.5(90)	147(11)	0.52(8)	228(35)	1.35(32)	0.22(85)	1.50(82)	0.229(23)	0.20(21)	127(187)
Oats	4.4(30)	58.7(26)	29.5(29)	74(5)	0.37(4)	292(10)	0.91(6)	0.23(32)	1.72(26)	0.133(8)	0.16(7)	119(61)
Wheat	6.0(1)	58.9(1)	40.7(1)	-	-	118(1)	1.15(1)	0.22(1)	1.26(1)	0.120(1)	-	113(3)
Mixed Cereal	4.1(16)	47.3(15)	25.3(16)	-	-	-	1.28(2)	0.23(17)	1.59(14)	0.398(1)	0.19(4)	92(25)
Rye	2.9(4)	45.0(4)	26.5(4)	-	-	182(4)	-	0.23(4)	1.47(4)	0.006(2)	0.17(1)	90(5)
OTHER SILAGES												
Corn	5.4(21)	51.4(18)	52.9(20)	68(6)	0.36(5)	624(10)	0.76(7)	0.25(18)	1.43(17)	0.011(8)	0.08(6)	100(25)
Triticale	3.6(5)	36.0(5)	29.8(5)	-	-	211(1)	-	0.14(5)	1.64(5)	0.020(1)	-	69(5)
Sunflower	4.4(1)	-	-	-	-	-	-	-	-	-	-	-
Pea + Other	5.5(21)	45.6(20)	37.3(21)	30(2)	-	100(5)	1.93(3)	0.24(21)	1.63(19)	0.100(5)	-	123(73)
Fababean + Other	4.3(1)	93.1(1)	27.0(1)	-	-	-	-	0.26(1)	-	-	-	118(25)
Canola + Other	5.0(1)	39.0(1)	28.0(1)	67(1)	-	140(2)	2.35(1)	0.40(1)	1.45(1)	0.062(1)	-	156(8)

- All values are on moisture-free basis.
- Values in brackets refers to the number of samples analysed.

Table 18: Average Macro and Trace Mineral Contents of LEGUME, LEGUME-GRASS AND GRASS SILAGES (1976-1986)

	Parts Per Million (ppm)							Per Cent (%)				Parts Per Billion
	Cu	Mn	Zn	Al	Co	Fe	Mo	Mg	K	Na	S	Se*
LEGUMES												
Legume(unsp.)												
Alfalfa	7.0(81)	34.7(78)	26.5(78)	200(5)	1.23(3)	235(33)	1.83(14)	0.32(73)	1.81(66)	0.035(31)	0.27(6)	258(119)
Clover	6.9(21)	42.3(20)	27.0(21)	585(5)	0.31(1)	281(7)	1.20(7)	0.36(18)	1.63(18)	0.016(7)	0.11(3)	147(47)
LEGUME-GRASS												
Legume-grass	6.8(137)	47.0(132)	27.4(136)	171(13)	1.50(2)	323(42)	1.62(30)	0.25(113)	1.68(112)	0.048(31)	0.20(28)	116(251)
Alfalfa-grass	6.5(97)	44.7(94)	25.8(97)	139(9)	0.56(1)	327(36)	1.77(21)	0.25(75)	1.74(74)	0.026(26)	0.18(14)	169(177)
Clover-grass	6.6(14)	61.0(14)	32.6(14)	65(1)	-	208(4)	1.12(1)	0.25(10)	1.48(10)	0.017(2)	0.11(3)	211(38)
GRASS												
Grass(unsp.)	7.0(5)	173.0(5)	26.5(5)	428(1)	-	418(3)	1.17(2)	0.25(7)	1.31(7)	0.143(2)	0.18(1)	162(11)
Brome	3.5(1)	63.3(1)	19.0(1)	-	-	96(1)	-	0.17(1)	1.11(1)	0.002(1)	-	75(2)
Bluegrass	5.2(8)	81.2(8)	29.0(8)	-	-	-	-	0.20(8)	2.13(8)	-	-	82(8)

- All values are on moisture-free basis.
- Values in brackets refer to the number of samples analysed.

Table 19: Average Macro and Trace Mineral Contents of STRAWS, SCREENINGS AND PROTEIN SUPPLEMENTS (1976-1986)

	Parts Per Million (ppm)							Per Cent (%)				Parts Per Billion
	Cu	Mn	Zn	Al	Co	Fe	Mo	Mg	K	Na	S	Se*
CEREALS STRAWS												
Wheat	3.9(9)	36.2(9)	10.0(9)	51(4)	0.16(1)	80(5)	0.80(4)	0.11(9)	1.12(9)	0.006(4)	0.08(4)	338(18)
Oats	3.2(26)	50.1(27)	18.9(26)	53(9)	2.16(1)	127(14)	1.09(10)	0.15(25)	1.41(24)	0.195(13)	0.13(14)	91(47)
Barley	3.1(47)	23.2(43)	14.1(47)	68(14)	-	125(23)	0.82(17)	0.12(40)	1.31(37)	0.131(22)	0.12(14)	165(58)
Mixed Cereal	3.3(85)	34.1(82)	15.2(85)	59(28)	1.63(3)	135(45)	0.98(33)	0.13(78)	1.33(74)	0.138(42)	0.12(34)	136(9)
OTHER STRAWS												
Fababeans	3.7(1)	23.3(1)	14.2(1)	61(1)	0.38(1)	88(1)	0.44(1)	0.18(1)	1.38(1)	0.119(1)	-	-
SCREENINGS												
Canola	3.9(1)	74.6(1)	75.4(1)	570(1)	1.03(1)	846(1)	0.88(1)	0.52(1)	1.19(1)	0.576(1)	-	356(7)
PROTEIN SUPPLEMENTS												
Soybean Meal	19.5(10)	39.0(10)	58.4(10)	28(4)	-	149(8)	-	0.35(9)	2.19(9)	0.011(7)	0.47(5)	609(16)
Canola Meal	6.4(91)	57.6(93)	74.4(93)	-	-	223(88)	0.66(3)	0.69(93)	1.31(29)	0.013(26)	1.12(33)	860(27)
Meat Meal	11.0(6)	32.2(7)	176.7(7)	127(3)	-	751(5)	0.89(1)	0.18(7)	0.66(7)	0.693(7)	0.49(3)	559(5)
Fish Meal	9.3(6)	22.7(6)	98.9(6)	188(3)	-	467(5)	0.45(1)	0.19(5)	0.87(5)	0.696(5)	0.83(3)	1752(5)

- All values are on moisture-free basis.
- Values in brackets refer to the number of samples analysed.

Table 20: Frequency Distribution Of Selenium, Copper, Zinc and Manganese Levels In ALFALFA HAYS AND SILAGES Analysed At A.S.A.N.L.*, 1980-1986

Selenium Number of Samples = 772 Average Level = 318 ppb

Se Content (ppb)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 100	169	21.9	169	21.9
100 to 199	168	21.8	337	43.7
200 to 299	157	20.3	494	64.0
300 to 399	102	13.2	596	77.2
400 to 999	150	19.4	746	96.6
1000 to 1999	22	2.8	768	99.5
2000 to 2999	2	0.3	770	99.7
3000 to 4999	1	0.1	771	99.9
5000 +	1	0.1	772	100.0

Copper Number of Samples = 453 Average Level = 6.9 ppm

Cu Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 5	114	25.2	114	25.2
5 to 7.9	195	43.0	309	68.2
8 to 9.9	92	20.3	401	88.5
10 to 19.9	50	11.0	451	99.6
20 to 24.9	2	0.4	453	100.0

Zinc Number of Samples = 446 Average Level = 24.1 ppm

Zn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	291	65.2	291	65.2
25 to 39.9	139	31.2	430	96.4
40 to 49.9	4	0.9	434	97.3
50 to 59.9	9	2.0	443	99.3
60 to 399.9	2	0.4	445	99.8
400 +	1	0.2	446	100.0

Table 20: (Cond't)

Manganese Number of Samples = 421 Average Level = 37.3 ppm

Mn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	108	25.1	108	25.7
25 to 39.9	194	46.1	302	71.7
40 to 49.9	66	15.7	368	87.4
50 to 74.9	28	6.7	396	94.1
75 to 99.9	24	5.7	420	99.8
100 to 299.9	1	0.2	21	100.0

* A.S.A.N.L. = Agricultural Soils and Animal Nutrition Laboratory.

Table 21: Frequency Distribution Of Selenium, Copper, Zinc and Manganese Levels In GRASS HAYS AND SILAGES Analysed At A.S.A.N.L.*, 1980-1986

Selenium Number of Samples = 623 Average Level = 182 ppb

Se Content (ppb)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 100	291	46.7	291	46.7
100 to 199	139	22.3	430	69.0
200 to 299	74	11.9	504	80.9
300 to 399	45	7.2	549	88.1
400 to 999	67	10.8	616	98.9
1000 to 1999	7	1.1	623	100.0

Copper Number of Samples = 424 Average Level = 5.8 ppm

Cu Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 5	244	57.5	244	57.5
5 to 7.9	130	30.7	374	88.2
8 to 9.9	23	5.4	397	93.6
10 to 19.9	15	3.5	412	97.2
20 to 24.9	4	0.9	416	98.1
25 to 79.9	8	1.9	424	100.0

Zinc Number of Samples = 420 Average Level = 24.6 ppm

Zn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	275	65.5	275	65.5
25 to 39.9	110	26.2	384	91.7
40 to 49.9	21	5.0	406	96.7
50 to 59.9	12	2.9	418	99.5
60 to 399.9	1	0.2	419	99.8
400 +	1	0.2	420	100.0

Table 21: (Cond't)

Manganese Number of Samples = 402 Average Level = 111.8 ppm

Mn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	30	7.5	30	7.5
25 to 39.9	88	21.9	118	29.4
40 to 49.9	53	13.2	171	42.5
50 to 74.9	38	9.5	209	52.0
75 to 99.9	181	45.0	390	97.0
100 to 299.9	12	3.0	402	100.0

* A.S.A.N.L. = Agricultural Soils and Animal Nutrition Laboratory.

Table 22: Frequency Distribution Of Selenium, Copper, Zinc and Manganese Levels In ALFALFA-GRASS HAYS AND SILAGES Analysed At A.S.A.N.L.*, 1980-1986

Selenium Number of Samples = 222 Average Level = 262 ppb

Se Content (ppb)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 100	49	22.1	49	22.1
100 to 199	51	23.0	100	45.0
200 to 299	56	25.2	156	70.3
300 to 399	27	12.2	183	82.4
400 to 999	37	16.7	220	99.1
1000 to 1999	2	0.9	222	100.0

Copper Number of Samples = 162 Average Level = 5.9 ppm

Cu Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 5	59	36.4	59	36.4
5 to 7.9	82	50.6	141	87.0
8 to 9.9	16	9.9	157	96.9
10 to 19.9	4	2.5	161	99.4
20 to 24.9	-	-	-	-
25 to 79.9	1	0.6	162	100.0

Zinc Number of Samples = 158 Average Level = 23.6 ppm

Zn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	116	73.4	116	73.4
25 to 39.9	37	23.4	153	96.8
40 to 49.9	3	1.9	156	98.7
50 to 59.9	1	0.6	157	99.4
60 to 399.9	-	-	-	-
400 +	1	0.6	158	100.0

Table 22: (Cond't)

Manganese Number of Samples = 150 Average Level = 40.8 ppm

Mn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	20	13.3	20	13.3
25 to 39.9	71	47.3	91	60.7
40 to 49.9	24	16.0	115	76.7
50 to 74.9	19	12.7	134	89.3
75 to 99.9	16	10.7	150	100.0

* A.S.A.N.L. = Agricultural Soils and Animal Nutrition Laboratory.

Table 23: Frequency Distribution Of Selenium, Copper, Zinc and Manganese Levels In OAT FORAGE (HAYS AND SILAGES) Analysed At A.S.A.N.L.*, 1980-1986

Selenium Number of Samples = 346 Average Level = 238 ppb

Se Content (ppb)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 100	172	49.9	172	49.9
100 to 199	60	17.4	232	67.2
200 to 299	40	11.6	272	78.8
300 to 399	24	7.0	296	85.8
400 to 999	40	11.6	336	97.4
1000 to 1999	4	1.2	340	98.6
2000 to 2999	2	0.6	342	99.1
3000 to 4999	2	0.6	344	99.7
5000 +	1	0.3	345	100.0

Copper Number of Samples = 166 Average Level = 5.3 ppm

Cu Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 5	92	55.4	92	55.4
5 to 7.9	59	35.5	151	91.0
8 to 9.9	8	4.8	159	95.8
10 to 19.9	5	3.0	164	98.8
20 to 24.9	1	0.6	165	99.4
25 to 79.9	1	0.6	166	100.0

Zinc Number of Samples = 162 Average Level = 25.5 ppm

Zn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	90	55.6	90	55.6
25 to 39.9	57	35.2	147	90.7
40 to 49.9	8	4.9	155	95.7
50 to 59.9	6	3.7	161	99.4
60 to 399.9	1	0.6	162	100.0

Table 23: (Cond't)

Manganese Number of Samples = 151 Average Level = 53.1 ppm

Mn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	17	11.3	17	11.3
25 to 39.9	50	33.1	67	44.4
40 to 49.9	21	13.9	88	58.3
50 to 74.9	15	9.9	103	68.2
75 to 99.9	48	31.8	151	100.0

* A.S.A.N.L. = Agricultural Soils and Animal Nutrition Laboratory.

Table 24: Frequency Distribution Of Selenium, Copper, Zinc and Manganese Levels In SLOUGH HAY Analysed At A.S.A.N.L.*, 1980-1986

Selenium Number of Samples = 44 Average Level = 155 ppb

Se Content (ppb)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 100	29	65.9	29	65.9
100 to 199	6	13.6	35	79.5
200 to 299	3	6.8	38	86.4
300 to 399	2	4.5	40	90.9
400 to 999	3	6.8	43	97.7
1000 to 1999	1	2.3	44	100.0

Copper Number of Samples = 26 Average Level = 5.5 ppm

Cu Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 5	12	46.2	12	46.2
5 to 7.9	9	34.6	21	80.8
8 to 9.9	2	7.7	23	88.5
10 to 19.9	3	11.5	26	100.0

Zinc Number of Samples = 25 Average Level = 29.4 ppm

Zn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	8	32.0	8	32.0
25 to 39.9	12	48.0	20	80.0
40 to 49.9	4	16.0	24	96.0
50 to 59.9	1	4.0	25	100.0

Table 24: (Cond't)

Manganese Number of Samples = 24 Average Level = 739 ppm

Mn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	-	-	-	-
25 to 39.9	1	4.2	1	4.2
40 to 49.9	-	-	-	-
50 to 74.9	-	-	-	-
75 to 99.9	15	62.5	16	66.7
100 to 299.9	8	33.3	24	100.0

* A.S.A.N.L. = Agricultural Soils and Animal Nutrition Laboratory.

Table 25: Frequency Distribution Of Selenium, Copper, Zinc and Manganese Levels In TIMOTHY HAY Analysed At A.S.A.N.L.*, 1980-1986

Selenium Number of Samples = 101 Average Level = 184 ppb

Se Content (ppb)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 100	46	45.5	46	45.5
100 to 199	24	23.8	70	69.3
200 to 299	15	14.9	85	84.2
300 to 399	4	4.0	89	88.1
400 to 999	10	9.9	99	98.0
1000 to 1999	2	2.0	101	100.0

Copper Number of Samples = 54 Average Level = 6.8 ppm

Cu Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 5	33	61.1	33	61.1
5 to 7.9	12	22.2	45	83.3
8 to 9.9	3	5.6	48	88.9
10 to 19.9	3	5.6	51	94.4
20 to 24.9	2	3.7	53	98.1
25 to 79.9	1	1.9	54	100.0

Zinc Number of Samples = 54 Average Level = 28.9 ppm

Zn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	28	51.9	28	51.9
25 to 39.9	15	27.8	43	79.6
40 to 49.9	5	9.3	48	88.9
50 to 59.9	6	11.1	54	100.0

Table 25: (Cond't)

Manganese Number of Samples = 50 Average Level = 61.1 ppm

Mn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	8	16.0	8	16.0
25 to 39.9	10	20.0	18	36.0
40 to 49.9	6	12.0	24	48.0
50 to 74.9	3	6.0	27	54.0
75 to 99.9	23	46.0	50	100.0

* A.S.A.N.L. = Agricultural Soils and Animal Nutrition Laboratory.

Table 26: Frequency Distribution Of Selenium, Copper, Zinc and Manganese Levels In OATS AND BARLEY GRAINS Analysed At A.S.A.N.L.*, 1980-1986

Selenium Number of Samples = 1147 Average Level = 123 ppb

Se Content (ppb)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 100	639	55.7	639	55.7
100 to 199	328	28.6	967	84.3
200 to 299	106	9.2	1073	93.5
300 to 399	34	3.0	1107	96.5
400 to 999	35	3.1	1142	99.6
1000 to 1999	5	0.4	1147	100.0

Copper Number of Samples = 515 Average Level = 5.7 ppm

Cu Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 5	264	51.3	264	51.3
5 to 7.9	188	36.5	452	87.8
8 to 9.9	30	5.8	482	93.6
10 to 19.9	30	5.8	512	99.4
20 to 24.9	1	0.2	513	99.6
25 to 79.9	1	0.2	514	99.8
115 to 799.9	1	0.2	515	100.0

Zinc Number of Samples = 507 Average Level = 38.4 ppm

Zn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	40	7.9	40	7.9
25 to 39.9	293	57.8	333	65.7
40 to 49.9	109	21.5	442	87.2
50 to 59.9	56	11.0	498	98.2
60 to 399.9	5	1.0	503	99.2
400 +	4	0.8	507	100.0

Table 26: (Cond't)

Manganese Number of Samples = 447 Average Level = 29.0 ppm

Mn Content (ppm)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 25	243	54.4	243	54.4
25 to 39.9	91	20.4	334	74.7
40 to 49.9	64	14.3	398	89.0
50 to 74.9	33	7.4	431	96.4
75 to 99.9	16	3.6	447	100.0

* A.S.A.N.L. = Agricultural Soils and Animal Nutrition Laboratory.

Appendix I

Publications containing macro and trace mineral data on Alberta feedstuffs can be obtained from the following:

1. Christensen, D. 1987. Trace Minerals for Reproduction in Beef Cows. Proceedings Alberta Beef Symposim, Edmonton, Canada, February 10 & 11, 1987.

2. Corbett, R. & Suleiman, A. 1987. Trace Minerals/Beef Cow Reproduction - Nutritionists' Perspective. Proceedings Alberta Beef Symposium, Edmonton, Canada, February 10 & 11, 1987.

3. Dudas, M.J. & Pawluk, S. 1977. Heavy Metals in Cultivated Soils and in Cereal Crops in Alberta. Can. J. Soil Sci. 57: 329-339.

4. Frischke, L. 1987. Trace Mineral Deficiencies - The Practicing Veterinarians Perspective. Proceedings Alberta Beef Symposium, Edmonton, Canada, February 10 & 11, 1987.

5. Horton, G.M.J. & McElroy, L.W. 1977. Nutrition Value of Sedge and Kentucky Bluegrass Hays Grown in Alberta. Can. J. Anim. Sci. 57: 187-193.

6. Maas, J. 1987. Selenium Deficiency in Beef Cattle: Diagnosis and Management. Proceedings Alberta Beef Symposium, Edmonton, Canada, February 10 & 11, 1987.

7. Martin, P.J. & Massey, D.L. 1973. Selenium deficiency in Alberta. Canadex 400.65.

8. Redshaw, E.S., Martin, P.J. and Laverty, D.H. 1978. Iron, Manganese, Copper, Zinc and Selenium Concentrations in Alberta Grains and Roughages. Can. J. Anim. Sci. 58: 553-558.

9. Suleiman, A. 1987. 1985 Average Analysis of Alberta Feeds, Agdex 100/81-5. Alberta Agriculture, Edmonton, Canada.

10. Suleiman, A. & Scheer, D. 1985. 1984 Average Analysis of Alberta Feeds, Agdex 100/81-4. Alberta Agriculture, Edmonton, Canada.

11. Suleiman, A. & Weisenburger, R. 1984. 1983 Average Analysis of Alberta Feeds, Agdex 100/81-3. Alberta Agriculture, Edmonton, Canada.

12. Average Analysis of Alberta Feeds 1976-1980. Agdex 100/81-2. Alberta Agriculture, Edmonton, Canada.

13. Walker, D.R. 1971. Selenium in Forage Species in Central Alberta. Can. J. Soil Sci. 51: 506-508.

14. Weisenburger, R.D. 1981. Levels of Trace Minerals Found in Alberta Feeds. Proceedings 2nd Western Nutrition Conference, Edmonton, Canada, September 15-17, 1981.

15. Westra, R. 1981. Hoof Problems in Cattle - Is There A Relationship With Trace Mineral Levels. Proceedings 2nd Western Nutrition Conference, Edmonton, Canada, September 15-17, 1981.

16. Westra, R. 1982. Sulfur and Other Mineral Concentrations in Feedstuffs Fed to Livestock in Various Regions of Alberta. Symposium: Acid Forming Emisson in Alberta and Their Ecological Effects, Edmonton, Canada, March 9-12, 1982.

Appendix II

TRACE MINERALS/BEEF COW REPRODUCTION - NUTRITIONISTS' PERSPECTIVE

Rick Corbett and Abdullatif Suleiman
Animal Nutrition Section
Alberta Agriculture
Edmonton, Alberta

Trace minerals are also commonly referred to as trace elements and micro minerals. The terms trace and micro do not refer to the importance of these nutrients but to the amounts required by animals. For example, one ounce of selenium is enough to meet the total requirements of a mature beef cow for 38 years. The same amount of copper would last 280 days. Even though the requirements for these nutrients is very small, the consequences of a deficiency can be severe.

Suggested Allowances of Trace Elements

Although several books and many articles have been written on trace mineral nutrition, our knowledge still contains many gaps. These gaps make it difficult for nutritionists to formulate firm recommendations regarding requirements. With our present understanding of the mineral problems in Alberta the allowances suggested in Table 5 appear to be reasonable where uncomplicated deficiencies occur. As has been pointed out by the previous speakers special circumstances do exist where individual farms may require higher levels of some of these trace minerals. These situations are best handled on an individual basis in consultation with a nutritionist competent in this area of nutrition.

Trace Mineral Content of Alberta Feeds

The trace minerals of greatest concern in Alberta are selenium, copper, zinc and manganese. The average content of these nutrients is often not a particularly useful measure of whether a problem exists or how severe it may be.

1. Selenium

The average content of feeds is variable with grass forages and grains being low and oat forage, alfalfa and alfalfa-grass mixtures

having more than adequate levels. (Table 1). However, when one looks at the proportion of feeds having less than the required amount the situation is a little more clear. Large amount of feeds grown here are deficient ranging from 43.7% of alfalfa to 84.3% of grains. It is well known that selenium deficiency is a problem in the province and that these deficiencies are more prevalent in certain areas of the province. The areas West of highway 2 and North of highway 16 have traditionally been identified as the deficient area. This implies that other areas are not deficient. Although this may be true on average, this is of little consequence to cattleman in this area whose feed is deficient. Feed testing is the best way to find out what your situation is.

2. Copper

The average level of copper in feed grown in the province would meet only 53-69% of cattle requirements (Table 2). The vast majority (88.5-96.9%) of the feed grown here supplies inadequate quantities of copper. Unlike selenium where the problem is more severe in some areas of the province, low copper is common in all areas.

3. Zinc

The average zinc content of forage is approximately half the level recommended for cattle with grain having somewhat higher levels, though still inadequate (Table 3). As with copper, the vast majority of feeds do not contain sufficient zinc to supply the needs of cattle. Low levels of zinc are common in all areas of the province.

4. Managnese

Manganese is probably the trace mineral of concern that has received the least attention by livestock producers, veterinarians and others associated with Alberta's livestock industry. The information in Table 4 strongly suggests that this situation needs to be remedied since 42.5 to 89% of feeds are too low to meet the suggested allowance for cattle. Similar to copper and zinc, low manganese levels are common in all areas of the province.

Nutrition and Reproduction

The nutritional focus of this symposium has been on the effect of trace mineral deficiencies on reproduction. This is not meant to suggest that trace mineral deficiencies are the primary or most important nutritional problems in Alberta related to reproduction in cattle. Other nutritional deficiency problems, having major effects on reproduction are common (Table 6). Each of these nutrients must be investigated whenever nutrition is suspected of contributing to or causing problems with reproduction.

The Alberta On Farm Situation

At this point we can conclude that most cattle producers in Alberta who are not making a conscious effort to supplement their rations with trace minerals, are likely experiencing problems with copper, zinc, manganese and possibly selenium deficiencies or at least are at risk of doing so. The question that each cattleman at this symposium should be asking is "What is my situation?". Unless you can answer this question based on facts, the only reasonable conclusion you can draw is that you do have problems.

Problems With Diagnosis

The previous speakers told us the symptoms of these nutrient deficiencies and if you haven't seen these signs in your herd, you at this point may have concluded that your cattle do not suffer these problems. This is a wrong conclusion based on this type of information.

Trace mineral deficiency problems are most often diagnosed on the farm based on observable and measurable symptoms. Those that can be diagnosed in this manner are the most severe cases where to the informed observer something is obviously wrong. Retained placenta and calf deaths from white muscle disease fall in this category. These are the clinical cases. It appears that the majority of the deficiency problems we see in Alberta related to selenium, copper, zinc and manganese are subclinical in nature. That is symptoms of the problem are difficult if not impossible to observe. Many producers may not even be aware that a problem exists. At present there is no practical way for us to measure these problems. Most of our laboratory tests measure clinical or near clinical

cases only. Even where subclinical problems are identified we most often have to diagnose the cause of the problem by process of elimination. In other words we identify what it is not and then speculate about what it may be. Once the "possible" causes of the problem are identified steps are taken to correct all or most of these at the same time. If the problem disappears we usually never know what caused it since we made several changes at once. For all we know the changes we made may have had no effect at all since the problem was going to disappear anyway. What we've said so far presumes that we do recognize problems where they exist. It's our opinion that the vast majority of trace mineral deficiency problems in beef cows go undetected. Just because we don't recognize these problems does not mean they don't exist. In the past 10 years that I have been working on trace element deficiencies in beef cattle, I have yet to meet a veterinarian who has a confirmed diagnosis of zinc or manganese deficiency in cattle and yet very large quantities of our feed do not contain enough of either of these to meet the requirments of our cattle. This observation must mean that most cattlemen supplement their herds with these elements at adequate levels or that the cattle do not need as much of these two as we think. We've come to the conclusion that neither of these situations can be true. Given this, the only other logical conclusion we can draw is that we are not able to diagnose these deficiency problems in the field in most instances.

How Big Is The Problem

At this point in the discussion it would be wise to ask ourselves several questions. If these problems are so difficult to recognize how do I find out if I have a problem? How big is the problem? Could it be less expensive to suffer the consequences of a trace mineral deficiency than to purchase the supplements to fix it?

Probably the most practical way to find out if you have a trace mineral deficiency problem is through feed testing. If the feed is low in one or more trace elements, provide a supplement that contains adequate levels of these. The most common source of supplemented trace minerals seems to be fortified or trace mineralized salt. At current prices cobalt-iodized (blue) salt blocks cost approximately $258 per tonne while one of the better trace mineralized salt products costs $260

per tonne. The blue salt contains no copper, zinc, manganese or selenium. The TM salt contains all of these at reasonable levels. Assuming that a mature cow would eat approximately 15 kg of salt per year the annual cost of the trace minerals would be 3 cents/cow assuming the same amount of salt is consumed. If we assumed that the cows eat 35% more loose salt, the most common form of TM salt, than block salt, the extra cost goes to $1.36 per cow per year. Of course trace mineralized salt blocks would cost even more, however this extra cost would be a result of the extra convenience of a block and not the extra cost of the trace minerals. The question now is will I get $1.36 per cow per year benefit? The next obvious question is in what way could I see a benefit?

Solutions And Benefits

Based on a few of the deficiency symptoms that Drs. Christensen and Maas have outlined we might expect benefits in increased weaning weights from more cows being bred and/or more cows becoming pregnant early in the breeding season. A summary of some work done in the area is provided in Table 8. As can be seen a general improvement in reproductive performance is seen when cattle are adequately supplemented with trace minerals. For example the cows became pregnant on average 11 days earlier when adequately supplemented with trace elements. This 11 day improvement would likely result in a conservative 20 pound increase in weaning weights which with 85 cent calves would increase income by $17 per calf weaned. Compared to what the typical extra cost of supplementation might be ($.03 - $1.39) you have to agree, it looks like money well spent.

There are other possible benefits. If trace mineral supplementation of the cow herd was done on a year round basis it appears likely that the calves would benefit from birth to weaning. What we've discussed so far is the added benefits of supplementing the cow up to the end of the breeding season. What about extra benefits of trace mineral supplementation on pasture or range? Does the calf continue to gain extra benefits from improved milk production by the cow and/or improvements in growth rate by the calf in addition to any extra milk it might receive. An on farm demonstration project in Alberta funded by Farming For The Future (FFF) indicate that there is (Table 9). In this trial one group of

cow-calf pairs was provided a salt fortified with copper, zinc, manganese and selenium (TM salt) and compared to a second group fed blue salt. The trace mineral supplemented calves gained 12 pounds more in pasture than the group not give extra trace elements. In another FFF project the improvement in gain was 20 pounds in favor of the trace mineral supplemented calves on range.

Conclusions

The feeds grown in Alberta are deficient in copper and zinc with a substantial portion also deficient in selenium and/or manganese. The results of FFF projects indicate that deficiencies of these trace minerals do exist in the province and do result in lost income. Field observations lead the writer to conclude that subclinical deficiencies are common and may be far more important in economic terms than the clinical problems with these elements. The opinion that trace mineral supplementation is expensive is obviously not correct. This past fall you could buy one tonne of trace mineralized salt for $260 and one tonne of cobalt-iodized salt for $234 a difference of $26/tonne or $0.65 per bag (all prices for 25 kg bags of loose salt F.O.B. Edmonton). Since a cow is not expected to consume a bag of salt per year, the annual extra cost of trace minerals alone can not be greater than 65¢ since this is the extra cost you pay for the trace elements in the salt.

Table 1

Selenium Content of Alberta Grown Feeds 1980-1986

	NUMBER OF SAMPLES ANALYSED	AVERAGE LEVEL (ppb)	% OF SAMPLES CONTAINING LESS THAN 200 ppb
Alfalfa	773	318	43.7
Grass	624	182	69.0
Alfalfa Grass	223	262	45.0
Oat Forage	346	238	67.2
Timothy	101	184	69.3
Grains	1158	123	84.3

Table 2

Copper Content of Alberta Grown Feeds 1980-1986

	NUMBER OF SAMPLES ANALYSED	AVERAGE LEVEL (ppm)	% OF SAMPLES CONTAINING LESS THAN 10 ppm
Alfalfa	453	6.9	88.5
Grass	424	5.8	93.6
Alfalfa Grass	162	6.0	96.9
Oat Forage	166	5.3	95.8
Timothy	54	6.8	88.9
Grains	515	5.7	93.6

Table 3

Zinc Content of Alberta Grown Feeds 1980-1986

	NUMBER OF SAMPLES ANALYSED	AVERAGE LEVEL (ppm)	% OF SAMPLES CONTAINING LESS THAN 50 ppm
Alfalfa	446	24.1	97.3
Grass	420	24.6	96.7
Alfalfa Grass	158	23.5	98.7
Oat Forage	162	25.5	95.7
Timothy	54	28.9	88.9
Grains	507	38.4	87.2

Table 4

Manganese Content of Alberta Grown Feeds 1980-1986

	NUMBER OF SAMPLES ANALYSED	AVERAGE LEVEL (ppm)	% OF SAMPLES CONTAINING LESS THAN 50 ppm
Alfalfa	421	37.3	87.4
Grass	402	111.8	42.5
Alfalfa Grass	150	40.8	76.7
Oat Forage	151	53.1	58.3
Timothy	50	61.1	48.0
Grains	447	29.0	89.0

Table 5

Suggested Allowances For Trace Minerals In Cattle Diets

	Allowance
Selenium	200 ppb
Copper	10 ppm
Zinc	50 ppm
Manganese	50 ppm

Table 6

Nutrient Deficiencies Commonly Found To Contribute To Reproductive Problems In Cattle In Alberta

.Protein
.Energy
.Phosphorus
.Vitamin A
.Selenium
.Copper
.Manganese
.Zinc
.Iodine

Table 7

Amount Of Trace Mineral Needed In Salt And Salt Mineral Supplement

Assumption: Cows eat 22 lbs of feed dry matter daily.
Cows will consume 2oz. (60g) of salt/mineral daily.
Cows will consum 1.5g (42g) of salt daily.

MINERAL	AMOUNT NEEDED AS A PERCENT OF REQUIREMENT	AMOUNT NEEDED IN A SALT	AMOUNT NEEDED IN A SALT/MINERAL
Selenium	100	48 mg/kg	35 mg/kg
Copper	100	0.24%	0.18%
Zinc	70	0.84%	0.63%
Manganese	60	0.72%	0.54%

Table 8

Influence Of Manganese, Copper And Zinc On Reproductive Performance Of Beef Cows

	Heifers			Cows		
Treatment	Control	+Mn	+Cu Mn Zn	Control	+Mn	+Cu Mn Zn
Days to First Estrus	86	66	75	No Difference		
Days to Conception	34	16	28	32	21	21

	Heifers And Cows		
Services per conception	1.6	1.1	1.0

Meiske J.C. et. al. 1985.
46th Minnesota Nutrition Conference

Table 9

The Effect Of Trace MineralSupplementation On Calf Gains On Pasture

	Gain On Pasture Lbs.	Difference Lbs.
TM Salt	242	12
Co-I Salt	230	

Lathwell D., L. Turner and D.N. Milligan
Farming For The Future Project 82-F001-2

Percent Of Feeds Containing Less Than The
Recommended Amounts Of Trace Minerals

	Copper	Zinc	Manganese	Selenium
	Less Than 10 ppm	Less Than 50 ppm	Less Than 50 ppm	Less Than 200 ppb
Alfalfa	88.5	97.3	87.4	43.7
Grass	93.6	96.7	42.5	69.0
Alfalfa Grass	96.9	98.7	76.7	45.0
Oat Forage	95.8	95.7	58.3	67.2
Timothy	88.9	88.9	48.0	69.3
Grains	93.6	87.2	89.0	84.3

Alberta Agriculture
1980-1986

References

1. Hughes, J.C., Plett, D. and Milligan, D.N. 1985. The Effect of Trace Mineral Supplementation on Calf Gains and Cow Breeding Performance. Farming For The Future Project #82-F002-2.

2. Lathwell, D., Turner, L. and Milligan, D.N. 1985. The Effect of Trace Mineral Supplementation on Calf Gains and Cow Breeding Performance. Farming For The Future Project #82-F001-2.

3. Meiske, J.C., DiCostanzo, A., Diallo, M. and Plegge, S.D. 1985. Trace Minerals for Beef Cattle. 46th Minnesota Nutrition Conference.